

Dairy Foods: Cheese and Dairy Products

T60 Prediction of process cheese functionality using dielectric spectroscopy. J. K. Amamcharla* and L. E. Metzger, *Midwest Dairy Foods Research Center, Dairy Science Department, South Dakota State University, Brookings.*

Process cheese (PC) is manufactured by blending and heating of natural cheese, emulsifying agents, sodium chloride, acidifying agents, water and other optional ingredients. The selection ingredients used in PC formulations play a crucial role in the functionality of the finished product. There is a need to develop a rapid method to predict the functional properties of PC. The objective of the study was to predict the functional properties of PC using dielectric spectroscopy. Dielectric properties of the PC were collected over the frequency range 0.2–3.2 GHz at a constant temperature (25°C). Dielectric spectra were collected using an open-ended high temperature dielectric probe (Agilent Technologies, Englewood, CO) connected to a vector network analyzer (Agilent Technologies). Dielectric spectra were collected in triplicate at 4 different locations in each sample. Twenty-four PCs were manufactured using a 3 × 2 × 2 factorial design using Intact casein content (ICC; levels: 14, 15.5, and 17%), cooking temperature (CT; 170 and 190°F), and cooking mixer speed (CMS; 100 and 350rpm) as independent variables. Partial least square regression (PLSR) and neural network (NN) models were developed using the dielectric spectra of PCs to predict the hardness (gf), melting point (°C) and modified Schreiber melt diameter (mm) of PC. Penetrometer, dynamic stress rheometry (DSR), and modified Schreiber melt (MSM) test were used as the reference methods, respectively. The PLSR and NN models were validated using the full cross-validation method. Root mean square error of crossvalidation (RMSECV) for PLS was found to be 2.5°C, 1.96mm, and 15.2gf for DSR melt point, MSM diameter, and hardness of PC, respectively. Similarly, RMSECV for NN was found to be 2.7°C, 2.1 mm, and 22gf for DSR melt point, MSM diameter, and hardness of PC, respectively. Practical utility of the calibration models were evaluated using the ratio of prediction error to deviation (RPD). The RPD was found to be > 2 for the 3 functional properties, indicating a good practical utility of the models.

Key Words: dielectric spectroscopy, process cheese, functional properties

T61 The impact of cation substitution on the flavor of reduced sodium full fat Cheddar cheese. E. Kang*¹, M. Kim¹, D. J. McMahon², and M. A. Drake¹, ¹North Carolina State University, Raleigh, ²Utah State University, Logan.

Sodium reduction is a key issue in the dairy industry as salt plays a crucial role in flavor and ripening of Cheddar cheese. Previous research showed that more than 30% sodium reduction negatively affected flavor development and consumer acceptance. Substitution of potassium chloride and small amounts of magnesium and calcium chlorides may maintain salty taste while minimizing sodium in cheese. The objective of this study was to evaluate the effect of partial salt substitution on flavor and flavor chemistry of full fat Cheddar cheese. Seven full fat Cheddar cheeses with the molar salt contents equivalent to 1.7% (wt/wt) sodium chloride (NaCl) but different ratios of sodium, potassium, calcium and magnesium cations were manufactured. Cheeses made using only NaCl at 1.7% (wt/wt) (C) served as positive controls while cheeses made using 0.7% (wt/wt) NaCl (LC) served as negative controls (LC). The experiment was replicated 3 times. Cheeses were ripened at 6°C and sampled for sensory, organic acids, and volatile compound

analyses through 9 mo of aging. Trained sensory panelists documented flavor attributes. Organic acids and volatile compounds were extracted and separated by high performance liquid chromatography or by solids phase microextraction with gas chromatography mass spectrometry, respectively. Consumer acceptance tests were performed after 6 mo. Salty taste intensity was consistent among cheeses except for the LC cheese, but other aromatic and basic taste differences were documented and these differences (bitter taste, sulfur and brothy flavors) increased with increased sodium cation substitution (>25%) or decreased salt (LC). Citric and lactic acids were higher in LC compared with other cheeses. Volatile compound differences were noted when more than 25% sodium was replaced. No differences in consumer liking were observed with up to 50% replacement of potassium with sodium ($P > 0.05$), and consumers on sodium restricted diets scored low sodium cheeses higher than those on unrestricted diets ($P < 0.05$). These results demonstrate that flavor and taste differences due to different cation salts will not affect consumer liking up to 50% sodium replacement.

Key Words: sodium, cheese, salt replacement

T62 A novel approach to produce low fat Cheddar cheese. I. Amelia*¹, D. M. Barbano¹, and M. A. Drake², ¹Cornell University, Ithaca, NY, ²North Carolina State University, Raleigh.

Our objective was to develop a new process to make low fat Cheddar cheese (LFCC) and compare its composition and properties to commercial full fat Cheddar cheese (FFCC) and commercial 50% and 75% reduced fat Cheddar cheese (RFCC). A RFCC (53% reduction) was produced using a fat removal process (Nelson and Barbano, JDS 2004) and then combined with dry micellar casein concentrate (MCC), water, and salt to achieve 6% fat, 28% protein, 1.2% salt in LFCC. The 6% fat target (83% fat reduction) was used to comply with the FDA low fat labeling regulation. The pH of the LFCC formulation was adjusted to 5.3 with lactic acid. Rennet was added, followed by pressing and packaging in 40 min total time. The cheese texture was conceptualized as a filled-gel model of protein matrix and filler (100% minus %protein). The filler volumes for FFCC, 50% RFCC, 75% RFCC, and LFCC were 75.8, 70.6, 67.4, and 70.3%, respectively, while the moistures were 35.7, 49.2, 52.5, and 58.1%, respectively. The RFCC had the hardest texture. The texture of the LFCC was more similar to the FFCC than either of the RFCC, even though the filler volume of the LFCC was similar to the 50% RFCC. The soft texture of our LFCC was because the original matrix structure of the starting FFCC was broken by blending. A new matrix structure was formed by the interaction of added rennet with the MCC resulting in a softer texture that was more similar to FFCC. Descriptive flavor scores were used to construct a PCA biplot to visualize flavor profile differences among cheeses. Both RFCC and LFCC were missing typical aged full-fat Cheddar flavor characters (nutty, brothy, catty, milkfat). The 50% RFCC and 75% RFCC were characterized by strong whey and cooked flavors while LFCC had bitter and grape-tortilla flavor which was thought to originate from the dry MCC. The sulfur flavor in LFCC was closer to FFCC, than both RFCC. The LFCC flavor produced by this method could be manipulated by adding flavoring ingredients (e.g., enzyme modified cheese) that could boost typical flavors of FFCC. Progress was made in development of a new LFCC making process that achieves a texture similar to FFCC, but the LFCC still needed improvement in Cheddar flavor characteristics.

Key Words: cheese, low fat, micellar casein

T63 Effect of grazing on Caciocavallo cheese quality produced in Alta Irpinia. G. Esposito*^{1,3}, A. Di Francia¹, F. Napolitano², M. L. Varricchio¹, A. Braghieri², and F. Masucci¹, ¹*Dipartimento di Scienze del Suolo, della Pianta, dell'Ambiente e delle Produzioni Animali, Università degli Studi di Napoli Federico II, Portici (Napoli), Italy*, ²*Dipartimento di Scienze delle Produzioni animali, Università degli Studi della Basilicata, Potenza, Italy*, ³*Department of Production Animal Studies, Faculty of Veterinary Science, University of Pretoria, Pretoria, South Africa*.

Dairy system in Alta Irpinia (Campania, southern Italy) is characterized by semi-extensive farms where cow feeding is based on grazing pasture in spring, and on hays and concentrates in winter. Milk is used to make a typical cheese named Caciocavallo. The aim of the study was to evaluate the effect of grazing on fatty acid (FA) profile, sensory properties and consumer liking of Caciocavallo made in Alta Irpinia. The study was conducted in 3 farms (A, B, C) and in 2 periods: spring (10 wk) and winter (10 wk). Pasture, feedstuff samples, milk and corresponding Caciocavallo cheeses were collected every 2 wk. Data on milk and cheese composition, cheese sensory properties and consumer acceptability were analyzed by GLM procedure, with season effect, farm and their interaction. To assess the FA transfer from milk to cheese, data of both FA profiles were compared by one-way ANOVA. Spring milk had higher contents of C18:0 (SEM 0.65; $P = 0.011$), C18:1t11 (SEM 0.03; $P < 0.001$), C18:3 (SEM 0.059; $P < 0.001$), CLA c9-t11 (SEM 0.087; $P < 0.001$). The cheese FA profile reflected the one of raw milk with few differences due to the aging process. Higher contents of C18:0 (SEM 1.17; $P = 0.01$), C18:3n-3 (SEM 0.01; $P = 0.007$), and CLAc9-t11 (SEM 0.21; $P = 0.004$) were observed in spring compared with winter cheeses. Sensory profile of spring cheese markedly differed across the 3 farms and the 2 periods. In particular, sensory profile of spring cheese produced from milk of cows fed natural pasture (farm A) differed from cheeses of cows fed sown pasture (farms B and C). A higher color intensity (yellowness) was observed in spring products (SEM 1.95; $P < 0.001$) due to the transfer of pigments (e.g., β -carotene) from fresh plants to the cheeses. Consumers expressed no preference for cheeses produced in different farms or seasons. This may be a consequence of the high temperatures (70–80°C) reached during the cheese making process possibly flattening the differences perceivable by untrained consumers. Overall, it is concluded that our work allowed the characterization and differentiation of Caciocavallo cheese produced in Alta Irpinia by different cattle feeding system.

Key Words: CLA, pasture, sensory properties and cheese quality

T64 Sensory and instrumental measure of temporal volatile release from cheese. S. White,* R. E. Miracle, E. A. Foegeding, and M. A. Drake, *North Carolina State University, Raleigh*.

Understanding what consumers experience during consumption of a food product is of great concern to manufacturers. This not only includes overall flavor and texture profiles, but the temporal duration and intensity of these attributes. Volatile compound and rheological tools have been extensively and successfully related to sensory perception. However, matching temporal changes by sensory and instrumental analyses remains a challenge. The objective of this study was to develop and validate an apparatus to measure dynamic volatile compound release from cheese and to verify this instrument with sensory analysis. Two provolone cheeses, made from the same lot of milk, were selected for their differences in free fatty acid flavor intensity. The free fatty acid profiles of the cheeses were analyzed by descriptive sensory analysis, solid phase microextraction gas chromatography (SPME-GCMS) and sensory time intensity. Additionally, a Seward Stomacher 80 Biomaster

lab system was modified to measure dynamic volatile release from these samples. The temporal volatile release (TVR) apparatus was designed to allow N₂ gas flow in the stomacher over the sample and through an outlet equipped for SPME fiber exposure. Volatiles were extracted after 10, 20 and 30 s of compression then quantified by GCMS. All experiments were conducted in triplicate. Statistical differences were analyzed using one-way ANOVA. Both sensory time intensity (TI) of free fatty acid flavor and the TVR showed differences ($P < 0.05$) between the cheeses not observed with traditional SPME-GCMS or by descriptive sensory analysis. The TVR volatile measurements were correlated with the sensory TI results ($r^2 = 0.88$, $P < 0.05$); and the TVR apparatus was able to measure differences in the relative volatile compound intensity of free fatty acids as well as the temporal release of these compounds. When used in conjunction with established sensory and flavor chemistry tools, this instrument can help food scientists understand what volatiles contribute to temporal perception of flavor.

Key Words: cheese flavor, time intensity, flavor release

T65 Light backscatter—Shedding new light on milk coagulation. R. Miller, A. Villarreal, B. Krahn, and L. Goddik,* *Oregon State University, Corvallis*.

The objective of this project was to evaluate the application of light backscatter technology to analyze the influences of somatic cell level, breed, parity, age of milk, and lactation stage on milk coagulation rate. Milk collected from individual cows ($n = 31$) was centrifuged to equalize fat composition and was tested during chymosin-induced coagulation. Coagulation rate was determined using diffuse reflectance to monitor changes in protein aggregation. Only breed and days in milk were significant with respect to milk coagulation rate. A student *t*-test was performed to evaluate differences in mean coagulation time between Holstein and Jersey milk. Coagulation of Jersey milk was significantly faster than Holstein milk. There was no evidence to suggest that somatic cell level affected coagulation rate. Initial pH of the milk was a significant indicator of SCC level, but was not a significant predictor of milk coagulation rate after the pH was equalized for all of the milks tested, suggesting that discrepancies in pH and not SCC level are what affect milk coagulation rate. The influence of milk age was also considered, using individual cow milk samples ($n = 6$) held for zero to 5 d. Coagulation rate did not vary significantly over the 5 d period. Overall, the results of this study indicate that only breed and days in milk significantly affect milk coagulation rate as measured by diffuse reflectance. The study also demonstrated that diffuse reflectance can be utilized to monitor milk coagulation rate.

Key Words: coagulation, SCC, quality

T66 Selection criteria for lactic cultures in reduced fat Cheddar cheese. A. C. Biswas,* A. N. Hassan, and L. E. Metzger, *Dairy Science Department, South Dakota State University, Brookings*.

The objective of this research was to screen several commercially available ropy strains of lactic acid bacteria for suitability in making reduced fat cheese with improved textural characteristics. Exopolysaccharide (EPS)-producing lactic cultures have been used to improve texture and meltability of reduced fat Cheddar and process cheeses. In our previous studies, among numerous cultures tested, the most successful strain in making reduced fat cheese was a highly ropy *Lactococcus lactis* ssp. *cremoris* (JFR) isolated from commercial buttermilk. Several single and mixed cultures of *Streptococcus thermophilus*, *Lactococcus lactis*, and *Lactobacillus delbrueckii* ssp. *bulgaricus* were obtained from

commercial sources and tested in this study. Cultures were screened for ropiness, and 5 highly ropy strains were selected. Selected strains were then evaluated against 2 control cultures: JFR and an EPS-negative culture. Rehydrated skim milk (11% w/w) steamed (95°C) for 15min. was inoculated with the test culture and fermented at the appropriate temperature (37°C for thermophiles and 32°C for mesophiles) to a pH value of 4.6. After overnight cooling at 4°C, fermented milk was tested for shear and heat stability, viscosity, water-holding capacity (WHC), and flow and viscoelastic properties. Milk fermented with JFR had the highest WHC, yield stress, consistency coefficient, ropiness, viscoelastic moduli, and shear stability. Water holding capacity determines moisture retention in cheese. The increase in viscoelastic moduli in the presence of EPS would indicate EPS-protein interactions which lead to stronger bodied, less pasty cheese, and lower whey viscosity (due to retention of EPS within the protein matrix). High heat and shear stability of EPS are important attributes in process cheese making. No direct relationship was found between ropiness and any of the tested traits. In conclusion, ropy cultures producing high water holding capacity, shear stability, consistency coefficient, yield stress, and viscoelastic moduli in fermented milk would produce reduced fat cheese with improved textural and melting properties.

Key Words: starter cultures, reduced fat cheese, exopolysaccharides

T67 Influence of salt levels, rate of salting and potassium chloride on whey syneresis from Cheddar cheese curd. Y. Lu* and D. J. McMahon, *Western Dairy Center, Utah State University, Logan.*

There is interest in lowering the sodium content of cheese by either reducing the amount of added salt or by replacing some of the sodium with potassium. Such changes have the potential to affect whey expulsion from cheese curd and subsequent mechanical handling of the curd after salting. Our objective was to determine effects on cheese curd syneresis of salting time intervals, salting levels, and 33% KCl molar substitution of NaCl. Four sets of unsalted fresh Cheddar curds were obtained and salted with different methods, with 3 replicates of each set on separate days. Set A was salted with 3.0% (wt/wt) NaCl over 3 applications either 5 or 10 min apart. Set B was salted with 3.0, 2.5, and 2.0% NaCl over 3 applications 5 min apart. Set C was salted with 2.0% NaCl using 1, 2, or 3 applications. Set D received salt consisting of a 2:1 molar ratio of NaCl and KCl over 3 applications 5 min apart. Whey was collected every 5 or 10 min until 30 or 40 min after the start of salting. Salted curds were pressed for 3 h. In general, whey expulsion started after the second salt addition, and with rapidly after the third application. Using 10-min salting intervals delayed whey syneresis but after pressing there was no significant influence on final cheese composition. Lowering salting levels significantly reduced the amount of whey expelled before pressing from a mean of 25 g/kg with 3.0% salt to 13 and 4 g/kg with 2.5 and 2.0% salting, respectively. This resulted in corresponding cheeses with higher moisture (35.6, 35.9, 37.0%) and slightly lower pH (5.3, 5.3, 5.2), respectively. In Set C cheese, adding 2.0% salt over one, 2, or 3 applications did not significantly affect cheese composition, with mean whey expulsion being ≤ 7 g/kg. Partial substitution with KCl did not affect amount of whey expelled or cheese moisture composition, although there was a slightly faster whey expulsion when using the NaCl/KCl mixture.

Key Words: cheese, salting, sodium

T68 Effect of different gums supplementation on textural properties of goat milk yogurts. Y. W. Park*¹, J. Oglesby¹, S. A. Hayek², R. Gyawali², and S. Ibrahim², ¹Fort Valley State University, Fort Valley, GA, ²North Carolina A&T State University, Greensboro.

Texture plays a significant role in sensory quality and consumer acceptability of fermented dairy foods. Casein gels are responsible for various rheological and textural properties of dairy products, such as yogurt and cheese. A study was conducted to evaluate the differences in textural properties of caprine milk yogurts fortified with 7 different kinds of gums during 4 weeks refrigerated storage. The experimental caprine yogurts were manufactured using goat milk produced at the Georgia Small Ruminant Research and Extension Center, Fort Valley State University, Fort Valley, with 0.2% addition of 7 different gums to pasteurized milk (w/v), which were: (1) xanthum, (2) modified food starch with agar pectin, (3) carrageenan, (4) locust bean, (5) carrageenan, maltodextrin, and dextrose, (6) guar, (7) modified food starch with gums 3, 4 and 5, and the yogurts were stored for 0, 2, and 4 wk at 4°C. Textural characteristics of all yogurts were determined using a texture analyzer (model TA.XT2i, Texture Technology Corp., Scarsdale, NY). Viscosity of the yogurts was measured by firmness (g force) and consistency, and adhesiveness or stickiness was measured by cohesiveness (g force) and index of viscosity. Firmness of control and 1 to 7 different gum added yogurts for the 0 and 4 wk storage were: 19.1, 23.0; 41.8, 63.7; 20.6, 22.2; 19.7, 20.9; 50.2, 64.7; 18.9, 19.7; 20.0, 20.8; 19.3, 21.1, respectively, indicating firmness of xanthum and locust bean fortified yogurts had significantly higher than control and the other gum treated groups. Locust bean showed the highest textural integrity among all tested gums. Viscosity, cohesiveness, and adhesiveness of #1 and #4 gums added yogurts were also significantly higher than the other yogurts. It was concluded that locust bean and xanthum were choice of gums for the best textural quality of caprine milk yogurt.

Key Words: goat milk yogurt, gums, texture

T69 The role of different sweeteners on WPI flavor contributions in acidic protein beverages. S. White* and M. A. Drake, *North Carolina State University, Raleigh.*

The modern consumer demands that food products have high nutritional value without sacrificing flavor. Among these products are high protein beverages that may contain low calorie sweeteners. Previous research has documented that processing steps in protein beverage manufacture may increase off flavors in the finished product. This objective of this study was to determine if different sweeteners affected WPI flavor contributions in WPI beverages after acidification and pasteurization. Duplicate lots of WPI were rehydrated to 10% solids (w/v) and sweetened with fructose, sucralose, or stevia followed by acidification to pH 3.2 and heat treatment at 85°C for 30 s. The experimental controls included unsweetened WPI, as well as deionized water sweetened with fructose, sucralose and stevia; all processed in the same manner. All treatments were evaluated by descriptive sensory analysis, solid phase microextraction gas chromatography mass spectrometry and gas chromatography-olfactometry. The experiment was repeated in triplicate and statistical differences were analyzed using one-way ANOVA and principal component analysis. WPI with different sweeteners were distinct in sensory and volatile profiles ($P < 0.05$). After acidification and heating, model beverages made with sucralose and stevia had higher soapy flavors than those sweetened with fructose; beverages with sucralose were also metallic. WPI model beverages with fructose had higher cabbage flavor, and higher dimethyl trisulfide concentrations after processing. However, other sensory differences were not confirmed by volatile analysis suggesting additional cognitive effects

on sensory perception. A comparison of sweetened water and sweetened WPI indicated that processing effects (heat and acidification) on the sweetener alone did not impart unique flavors. Sweeteners influenced sweet taste quality and temporality and enhanced soapy or cabbage flavors contributed by WPI. These results demonstrate that sweetener type influences sensory properties (aromatics and basic tastes) of whey protein beverages.

Key Words: WPI, protein beverages, sweeteners

T70 Concentrations of IGF-1 and IGFBP-3 in several Korean commercial dairy products by immunoradiometric assay. S. H. Kang,* D. W. Kim, K. H. Kim, K. S. Kim, and S. C. Baick, *Seoul Dairy Cooperative R&D Center, Shingil-dong, Ansan-si, Kyunggi-do, Republic of Korea.*

Insulin-like growth factor-1 (IGF-1) is a mitogenic polypeptide with a molecular structure similar to that of insulin which stimulates growth, differentiation and metabolism in a variety of cell types by acting through IGF-1 receptors. Milk-derived growth factors may also mediate the growth of tissues not directly associated with the GI tract and may have greater implications for overall growth and development of the neonate. The objectives of this study were to determine the change of insulin-like growth factor-1 (IGF-1) and of insulin-like growth factor binding protein-3 (IGFBP-3) content in commercial dairy products marketed in Korea. IGF-1 content was determined by immunoradiometric assay (IRMA). All the experiments were triplicated and the data were analyzed by the SAS system using a procedure of ANOVA. There were no significant differences in IGF-1 content by different pasteurization methods between HTST and UHT heat treatment. The mean IGF-1 content of commercial market milk, plain yogurt, skim milk powder, infant formula and sweet cheese whey powder was 2.3 ± 0.6 , 8.7 ± 0.8 , 4.8 ± 0.1 , 4.1 ± 0.4 and 7.8 ± 0.2 ng/mL, respectively. However, the concentrations of IGFBP-3 in all the dairy products could not be measured by using commercially available human IGFBP-3 IRMA kits (<1.0 ng/mL), because the kits were generated against human IGFBP-3 epitopes and failed to recognize bovine milk IGFBP-3. The IGF-1 content in unprocessed milk has been reported in the range of 1.27 - 8.10 ng/mL. It was concluded that the concentration of IGF-1 in the examined milk products was not altered by homogenization, conventional heat treatment or spray drying.

Key Words: IGF-1, IGFBP-3, immunoradiometric assay

T71 The fatty acid composition of butter and cultured butter with lactobacillus acidophilus added to starter. O. Tsisaryk*¹, L. Musij¹, and O. Golubets², ¹*Lviv National University of Veterinary Medicine and Biotechnologies, Lviv, Ukraine,* ²*Ukrainian State Research and Production Centre for Standardization, Metrology, Certification and Consumer Rights Production, Kiev, Ukraine.*

Our purpose was to create butter which would combine functional properties probiotics and increase the content of CLA. Some fermented dairy products contain higher levels of CLA than non-fermented, and the yield of CLA was dependent on the species of lactic acid bacteria inoculated. Some studies have shown that among lactic cultures inoculation of *L. acidophilus* into milk was most effective in promotion c-9,t-11-CLA formation. The objective of the study was to determine the fatty acid composition of sweet butter and cultured butter when a *L. acidophilus* was added to the starter. Control butter was churned from sweet cream (SB) and cultured butter (CB) from fermented cream. The cream was fermented by the starter Flora Danica Chr. Hansen (*Lac. lactis*, *Lac. cremoris*, *Leu. cremoris*, *Lac. diacetylactis*) at 20°C (CB1); Flora Danica

and *L. acidophilus* La-5 (1:1) at 20°C (CB2); and Flora Danica and *L. acidophilus* La-5 (1:1) at 30°C – a more comfortable temperature for *L. acidophilus* (CB3). The experiment was replicated 3 times. Butter samples were stored at -20°C until the fatty acid analysis by GLC. The FAME were separated on a column (100 m × 0.25 mm × 0.2 μm [HP-88] 88%-cyanopropyl aryl-polysilixane, Agilent Technologies) in a chromatograph (Hewlett Packard 6890). All samples of butter contained similar concentrations of total trans-isomers, transvaccenic acid (4.0%) and c-9,t-11-CLA (1.9%). The content of butyric acid increased from 4.0 in SB to 4.3–4.4% in CB ($P < 0.05$). The sum of branched-chain fatty acids decreased from 2.6 in SB to 1.8% in CB; the percentage anteiso-C14:0 was 0.8% in SB, but it was not detected in CB. The content of C14:1 was 1.74% in cultured samples, but only 0.9% in SB. The sum of unpaired fatty acids was the same in all samples. The percentage of the sum of medium-chain saturated fatty acids (C12-C16) decreased from 40.8 in SB, CB1, and CB2 to 40.5% in CB3 ($P < 0.05$). It was concluded that there were not significant differences in fatty acid composition between the samples of cultured butter, but there were some differences between sweet and cultured butter in content of short- and branched-chain fatty acids.

Key Words: butter, cultured butter, fatty acids

T72 Effect of sodium reduction on the survival of *Listeria monocytogenes* and *Bacillus anthracis* in Cheddar cheese. E. Hystead,* F. Diez-Gonzalez, and T. C. Schoenfuss, *University of Minnesota, St. Paul.*

Reduction in sodium intake is a public health priority. Cheddar cheese is a targeted food for sodium reduction efforts because of its relatively high salt content. One of the roles of salt in cheese is the inhibition of spoilage and pathogenic microorganisms. Additionally, a bioterrorism attack on the milk supply with an agent that survives pasteurization, such as *Bacillus anthracis*, could be used against cheese. The objective of this study was to determine the ability of *Listeria monocytogenes* and *Bacillus anthracis* to survive in Cheddar cheese at reduced and low sodium levels. Stirred curd Cheddar cheese was manufactured separately with 2 different starter cultures, and 5 salting treatments: full sodium, 25%, and 55% reduced sodium with and without potassium chloride (KCl) addition. Shredded cheese from each treatment was inoculated with 5 strains of *L. monocytogenes* or 2 strains of *B. anthracis*, and stored at 4° and 12°C. Enumeration of pathogens, and aerobic count, and lactic acid bacteria was performed at regular intervals over 30 to 60 d. Water activity, pH and moisture were also monitored. *L. monocytogenes* count declined by 4 log cfu/g in all treatments after 60 d at 4°C. Results from subsequent experiments with higher inocula and higher pH, showed no more than 1 log cfu/g decrease in counts in all treatments. Furthermore, the 55% reduced sodium treatment had no reduction at all. The populations of *L. monocytogenes* (at 12°C), *B. anthracis*, aerobic count, and lactic acid bacteria survived consistently at 5, 6, 5.5, and 8.5 log cfu/g respectively, at any temperature or salting treatment. Survival of *L. monocytogenes*, and *B. anthracis* appeared to be due to an increase in pH of stored Cheddar cheese from averages of 4.7 to 5.4 over 6 mo. These results indicate that pathogens were able to survive in Cheddar cheese, regardless of sodium reduction level, but this survival was dependent on pH. In the event of an accidental or intentional contamination, reduction of sodium may increase the risk of pathogen survival if the pH of Cheddar cheese is not sufficiently low.

Key Words: Cheddar cheese, sodium reduction, food safety

T73 Effects of acidification of milk by glucono- δ -lactone (GDL) on the solubility of milk protein concentrate powder. H. Eshpari*^{1,2}, M. Corredig¹, and P. Tong², ¹University of Guelph, Guelph, Ontario, Canada, ²California Polytechnic State University, San Luis Obispo.

A limiting factor in using milk protein concentrates (MPC) as a high quality protein source for different food applications is their poor reconstitution properties. It is known that in native casein micelles, there is an optimal balance of hydrophobic and electrostatic interactions; however, acid-induced changes of casein micelles have disruptive effects on the attractive and repulsive forces in casein micelle structure. Depending on the extent of disruption, different structures of acid modified micelles are obtained, that may result in different solubility and functional properties of casein micelles. The main objective of this study was to investigate the effects of acidification of milk by glucono- δ -lactone (GDL) before ultrafiltration on the reconstitutability of MPC powders. Milk protein concentrate 80 powders were manufactured in duplicate by ultrafiltration, diafiltration, and spray-drying using milk (~pH 6.6) and GDL-treated milk (pH 6.0). Powder samples were tested in duplicate for reconstitutability, particle size and microstructure. It was observed that acidification of milk to pH 6 significantly increased ($P < 0.001$) the mean solubility of milk protein concentrate from 79.81 to 90%. Particle size analysis and scanning electron microscopy (SEM) observations showed no significant difference in the mean particle size distribution and microstructure of the powder due to the effect of milk acidification. Mineral content and casein micelle structure of the powders need to be investigated to better understand the beneficial effect of milk acidification on solubility. Overall, this study demonstrates the importance of milk acidification and pH in determining the solubility of milk protein concentrate.

Key Words: acidification, milk protein concentrate, solubility

T74 Influence of ethanol on some characteristics of stirred yogurt. B. Mena*^{1,2} and K. Aryana^{2,1}, ¹Louisiana State University, ²Louisiana State University Agricultural Center.

Alcohol is used in manufacture of some products such as egg nog. The objective was to study the effect of ethanol on the growth of yogurt culture bacteria and the physico-chemical characteristics of stirred yogurt. The treatments were 0% (control), 2.5%, 5% and 7.5% v/v of ethanol. The ethanol was incorporated by stirring it into one day old plain yogurt. Product characteristics were studied weekly for 4 weeks of refrigerated (4°C) storage. Data were analyzed using Proc Mixed model of Statistical Analysis System. The ethanol*storage time interaction effect was significant for *Lactobacillus bulgaricus* counts. The storage time effect was significant for *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, pH and titratable acidity (TA). Ethanol incorporation in yogurt did not influence the counts of *Streptococcus thermophilus*, *Lactobacillus bulgaricus* nor the viscosity of the yogurts. Ethanol incorporation in yogurt significantly influenced pH and TA of the yogurts. The pH of the control yogurts were significantly lower than yogurt with 7.5% ethanol, while there were no differences between the control and yogurts with 2.5 and 5% ethanol. Control yogurts had significantly the highest TA followed by yogurts with 2.5% ethanol while yogurts with 5 and 7.5% ethanol had significantly the lowest TA values not different from each other. Yogurts with ethanol can successfully be manufactured without adversely influencing counts of its culture bacteria over product shelf life.

Key Words: yogurt, ethanol, culture